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ESTIMATING VOLUME FROM STUMP MEASUREMENTS

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This report is from the
Division of Forest Economics
CENTRAL STATES FOREST EXPERIMENT STATION

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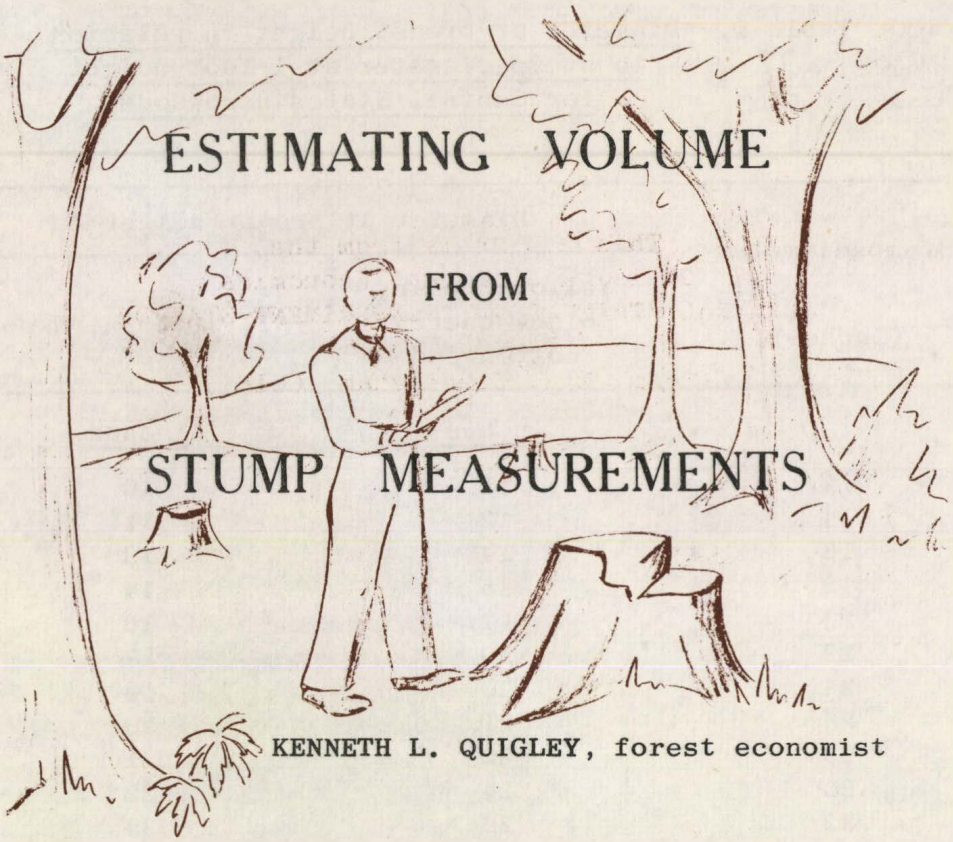


KENNETH L. QUIGLEY, forest economist

Foresters sometimes have to estimate the volume of timber harvested from the stumps that remain after logging. Such estimates may be needed when the timber cutters have crossed property lines or when they have removed trees not marked for cutting. Stump measurements on sample areas may also be used for state or regional estimates of the volume of timber cut annually, instead of the usual timber-production survey.

In order to test this stump method of estimating volume of timber harvested, the Central States Forest Experiment Station has been tallying stumps on field sample plots for several years in statewide surveys of forest resources. In addition to the stump measurements, it was necessary to determine: (1) Relation of stump diameter to breast-high diameter and (2) merchantable length of cut trees.

2,700 Trees Measured

The relation of stump diameter to breast-high diameter of Central States hardwoods was determined by measuring the diameters of about 2,700 standing trees both at breast height and at the assumed stump height of 1 foot. These trees were measured on randomly selected Forest Survey inventory plots located throughout Indiana and Ohio. Table 1 shows average breast-high tree diameters for stumps of given diameters.

Table 1.--Diameter at breast height in relation to stump diameter at 1-foot height for Central States hardwoods

Stump diameter (Inches)	Diameter at breast height	
	Yellow-poplar, black cherry, cottonwood	All other hardwoods
	Inches	Inches
12	11	10
14	12	11
16	14	13
18	15	14
20	17	16
22	19	17
24	20	18
26	21	20
28	22	21
30	24	22
32	26	24
34	27	25
36	28	26

Merchantable Length Poses Biggest Problem

The merchantable length of the harvested tree is difficult to determine accurately. If the logging was fairly recent, log lengths may be estimated from such clues as the number and distance between sawdust piles, distance from stump to unused top, depressions caused by the logs, and other similar evidence. However, log skidding, weather, or animals may obliterate these signs or make them unreliable. Another method of estimating the merchantable lengths of the cut trees is to measure the merchantable lengths of similar trees still standing on the tract or on adjacent tracts.

If neither of these methods is feasible, tables showing average merchantable length by species and tree diameter must be found or made. The merchantable length to a minimum 8-inch top of important Central States hardwoods was measured on logging operations located throughout Illinois, Indiana, Kentucky, and Ohio. In all, some 500 cut trees were measured and the results averaged (table 2).

These lengths are applicable to average trees only and should not be used if conditions vary greatly from the average. For example, if all trees were on an extremely dry ridgetop, they might average one log or less merchantable length regardless of d.b.h. or species. Conversely, in a fertile, well-drained bottom, most trees might have three or four good 16-foot logs. In such cases merchantable lengths should be estimated from trees still remaining on the tract or on similar tracts.

Table 2.--Average number of 16-foot logs per tree by d.b.h. and species group for Central States hardwoods

D.b.h. (Inches)	Species group[1/]			
	I	II	III	IV
12	1.5	1.5	2.0	2.0
14	2.0	2.0	2.0	2.5
16	2.0	2.0	2.5	2.5
18	2.0	2.0	2.5	3.0
20	2.0	2.5	2.5	3.0
22	2.0	2.5	2.5	3.0
24	2.0	2.5	2.5	3.0
26	2.0	2.5	2.5	3.5
28	2.0	2.5	3.0	3.5

1/ I -- White oaks
II -- Beech, maple, elm, hickory, and others
III -- Red oaks, sycamore, and sweetgum
IV -- Yellow-poplar and basswood

All-Purpose Volume Table Needed

The final step in determining the volume of the harvested trees is to read board-foot volumes from an appropriate volume table. For this purpose an all-purpose volume table built up from several species volume tables should provide sufficiently accurate volumes. The volume table shown in table 3 is based on form-class measurements of some 500 trees in Indiana. It is the volume table

used in the Forest Survey of Indiana for oak, elm, soft maple, and basswood. Other hardwoods varied rather consistently from the volumes shown in the standard table: Ash, cottonwood, sweetgum, walnut, and cypress volumes averaged 90 percent of the table 3 volumes; hickory, yellow-poplar, sycamore, and pine averaged 95 percent; hard maple 110 percent; and beech 120 percent. Often the volume differences are compensating so that the table without modification is usually satisfactory. Volume tables used in the other Central States did not differ greatly from the Indiana all-purpose table shown.

How to Use the Tables

To estimate timber volume when only the stumps are available, first tally the stumps by species and diameter at 1-foot height. Then convert the stump measurements to d.b.h. using table 1, and determine the number of logs in the cut trees from table 2 or from measurements of similar trees not yet removed from the tract. Finally, read the appropriate volumes from table 3.

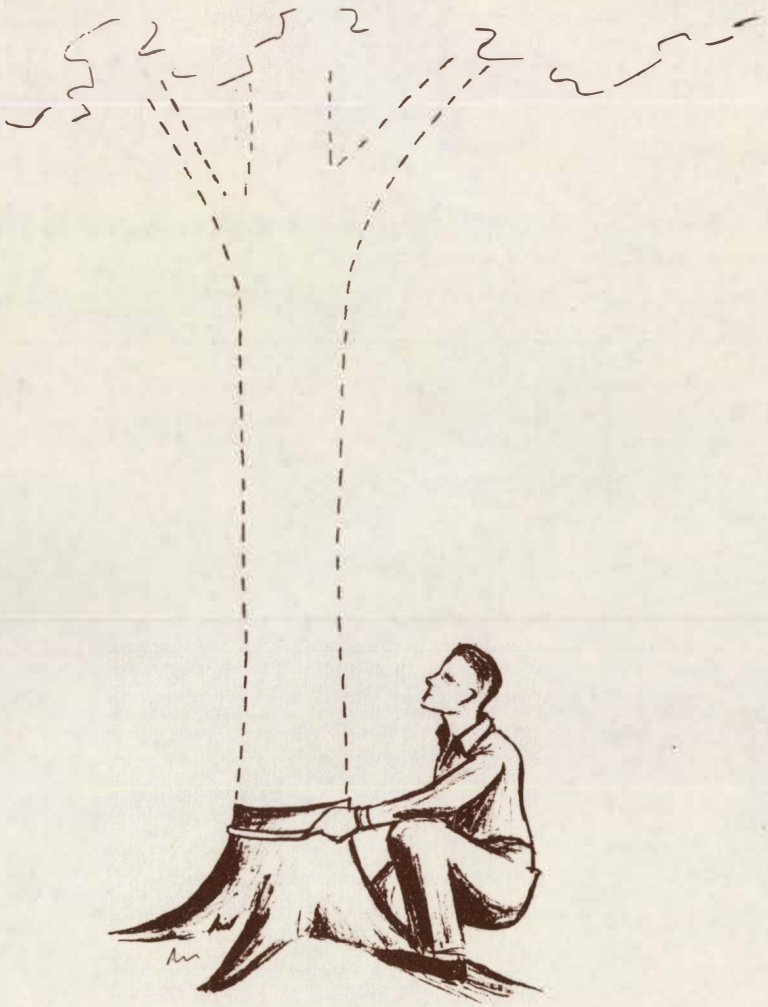
Board-foot volume estimates made from stump measurements by this method are not likely to be accurate when applied to only a few trees. However, this method should give reliable estimates if several thousand board-feet are involved.

Table 3.--Central States hardwoods gross volume table
(Board-feet, International 1/4-inch rule)

D.b.h. (Inches)	Number of 16-foot logs per tree									
	1/2	1	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2	5
12	27	52	68	85	98	110				
14	40	77	103	129	149	169	182	196		
16	56	106	143	180	210	241	263	285		
18	74	136	184	233	274	314	344	374		
20	93	171	234	296	348	401	440	480	511	542
22	115	211	290	368	434	500	552	603	647	691
24	140	251	346	441	523	605	664	723	782	840
26	168	299	414	528	626	725	801	877	949	1021
28	197	347	482	616	733	850	938	1027	1114	1201
30	230	403	560	718	854	991	1094	1198	1306	1415

Stump Survey Versus Production Survey

Admittedly a stump survey, as a method of estimating timber cut, does not provide very accurate information about the products for which the timber is cut. And, moreover, some training is needed in determining the date the cutting occurred. But on the other hand, such a survey has several advantages over the standard industry production sampling survey: (1) It is cheaper, if done as a part of the inventory survey; (2) it gives detailed information about the size and species of trees cut, and (3) it gives information on the acres of forest land cut over as well as the volume cut per acre.



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